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ASSISTING DEFENSE CONVERSION TECHNOLOGY TRANSFER EFFORTS: A CASE STUDY OF OHIO'S MIAMI VALLEY

THESIS

Marissa C. Salvador, Captain, USAF

AFIT/GSM/LAL/95S-6

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Wright-Patterson Air Force Base, Ohio

AFIT/GSM/LAL/95S-6

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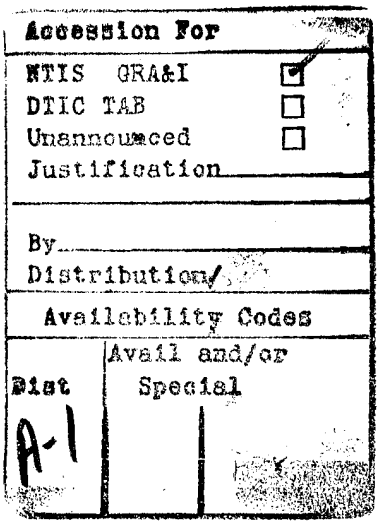

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ASSISTING DEFENSE CONVERSION TECHNOLOGY TRANSFER EFFORTS: A CASE STUDY OF OHIO'S MIAMI VALLEY

THESIS

Presented to the Faculty of the School of Logistics and

Acquisition Management

Air Education and Training Command

In Partial Fulfillment of the

Requirements for the Degree of

Master of Science in Systems Management

Marissa C. Salvador, B.S.

Captain, USAF

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Abstract

Major changes in the geopolitical environment and the social and economic needs of the United States have resulted in resources being shifted away from national defense. Although the expected decrease in defense spending should not be harmful in macroeconomic terms, it can be devastating locally. To mitigate the effects of the drawdown, individual states and local communities must search for ways to bolster their local economies. One avenue that can be pursued to enhance future economic growth is the transferring of technologies to the commercial sector. Intermediary organizations have emerged to facilitate the process of technology transfer by serving as the bridge between technology providers and industrial users.

This research investigates and describes how intermediary organizations are assisting and facilitating the technology transfer defense conversion efforts. A case study examines how four Miami Valley organizations in Ohio are helping to promote economic growth and development in their local area via technology transfer.

ASSISTING DEFENSE CONVERSION TECHNOLOGY TRANSFER EFFORTS: A CASE STUDY OF OHIO'S MIAMI VALLEY

I. Introduction

General Issue

Since the Second World War, the United States has undergone three major defense reductions after three major military conflicts: World War II, the Korean War, and the Vietnam War (Minnich, 1993:112; Stewart, 1993:1). With the end of the Cold War, the United States again faces the challenge of defense conversion.

Major changes in the geopolitical environment and the social and economic needs of the United States have resulted in resources being shifted away from national defense (Wingrove, 1993:iii). With this reduction in defense spending, the entire defense environment is undergoing dramatic changes. Defense firms are shrinking to adjust to the drawdown. Some are searching for new markets in the commercial sector, while others are merging with other companies attempting to remain competitive in the defense business. Defense-related personnel, whether military, Department of Defense (DoD) employees, or defense contractors, are seeking employment in the commercial sector. Although this drawdown is the mildest and most gradual of the past half-century, its

consequences still significantly impact individuals, local communities, and their economies (Defense Conversion Commission, 1992:7).

The drawdown has been viewed in various conflicting ways; such as an opportunity to convert defense industry to peacetime uses, a drain on the economy, a budgetary source of "peace dividends," or as a reward or a punishment for winning the Cold War (Defense Conversion Commission, 1992:i). Regardless of the way it is viewed, the perceived outcomes of the drawdown have led the federal government to get involved and to take actions designed to help alleviate negatively anticipated outcomes and encourage desirable ones (Defense Conversion Commission, 1992:i).

To help assess the consequences of the defense drawdown, the Defense Conversion Commission was formed in 1992. It was created to report on the effects of the defense drawdown and make recommendations on government programs designed to facilitate the transition to non-defense endeavors (Defense Conversion Commission, 1992:1). The Commission defined defense conversion broadly as the process by which the people, skills, technology, equipment, and facilities in defense are shifted into alternative economic applications. Although the Commission recognized the importance of federal assistance programs and their transitory role in helping ease the hardship, it strongly emphasized the necessity for individual states, local communities and companies to take an active role in the defense conversion process. It is companies who will ultimately be the providers of new jobs and the "long-term engines of economic growth"

("Ensuring Defense Industrial Base Capacities, Capabilities", 1993:23; Defense Conversion Commission, 1992:17).

Specific Issue

The expected decline in defense spending should not be harmful in macroeconomic terms, but it can be devastating locally (Lynch and Dickens, 1993:79). Defense cutbacks do not occur uniformly throughout the economy, thus specific actions to address the impacts of the drawdown must be tailored to the unique requirements of individual communities.

Communities that are dependent on defense spending are potentially more likely to feel the impacts of the drawdown. One industrial sector that will bear the brunt of the drawdown is manufacturing. The Department of Defense purchases more from the manufacturing sector than any other sector (Wingrove, 1993:1-2). Because of the specialized nature of many military products, defense manufacturing industries have become increasingly segregated from the commercial sector and heavily reliant on defense-related business. As a result of the defense spending reduction coupled with this defense-dependency, their business bases are expected to suffer very large reductions. The four industrial groupings that are projected to endure the greatest decline are missiles, tanks, and ordnance (36%); communication and navigation equipment (23%); aircraft and aircraft engines and parts (21%); and missile engines and parts (11%) (Wingrove, 1993:1-4).

Although the drawdown appears to significantly affect particular industrial sectors, it similarly impacts particular geographic locations, such as the handful of states that account for the majority of DoD purchases and jobs. According to a Logistics Management Institute Report, Impacts of Defense Spending Cuts on Industry Sectors, Occupational Groups, and Localities, fifty-nine percent of Department of Defense's direct and indirect purchases and 59.4 percent of defense-related jobs are concentrated in 10 states, one of which is Ohio (Wingrove, 1993:1-4).

Although the drawdown is a national problem, the solutions must be tailored to specific areas and industries. The challenges facing individual states and communities can be significantly diverse. Individual states and local communities must search for ways to bolster *their* local economies and mitigate the effects of the drawdown (Joint Economic Committee, 1992:120). Their focus should be on promoting long-term economic growth that will provide the necessary opportunities for their dislocated workers and resources (Defense Conversion Commission, 1992:2).

As President Clinton indicated in his Technology for America's Economic Growth, A New Direction to Build Economic Strength, technology plays a critical role in stimulating and sustaining long-term economic growth that creates high quality jobs. One avenue that can be pursued to enhance future economic growth is the transferring of federal technologies to the commercial sector. Federal laboratories can provide benefits for cooperating and collaborating small businesses and corporations. These benefits include new technologies that can be commercialized, the evaluation of technologies

developed by companies, the use of specialized equipment for testing, and federal lab staff's expertise to help solve special technical problems (Rood, 1989:15). State and local governments can use spin-off federal technologies indirectly by channeling them to local businesses and entrepreneurs.

Ohio is one state that has taken a proactive role in technology transfer. Its Miami Valley is uniquely situated to take advantage of the accessibility of federal technologies. With a premier federal laboratory, Wright Laboratory, located at Wright-Patterson Air Force Base in Dayton, the Miami Valley has a "gold mine" in its own backyard (Stricharchuk, 1995:3G). The Miami Valley can use technology transfer as a means to improve its standard of living by increasing its public and private sector productivity, creating new industries and employment opportunities, and enhancing their competitiveness.

The numerous opportunities and potential benefits of combining federal technology resources with the local industrial needs have spurred the development of entrepreneurial organizations that act as "scouts" to facilitate the technology transfer process. Several such intermediary organizations have sprung up in the Miami Valley. These recently formed organizations serve as the bridge between the technology provider and the industrial user.

Research Objective

The objective of this research is to investigate and describe how Miami Valley intermediary technology organizations are assisting and facilitating the technology transfer defense conversion efforts to help promote economic growth and development in the local area.

Investigative Questions

To investigate the research objective, this study will examine the following investigative questions:

1. What role do these intermediary organizations play in the Miami Valley's defense conversion process?
2. What mechanisms/methods/techniques are used to facilitate and encourage the area's technology transfer efforts?
3. How do the various organizations interact with one another to achieve economic growth and development in the Miami Valley area?

Thesis Overview

Chapter II presents a literature review of the history of past defense conversion efforts, the recommendations of the Defense Conversion Commission, and an overview of the federal legislation enacted to promote technology transfer/defense conversion, and a summary of existing technology transfer research. Chapter III describes the case study methodology used in this research, as well as the population of interest and the research instruments used. Chapter IV describes the four local Miami Valley organizations in this case study and how they aid in the defense conversion process by facilitating technology

transfer activities. Chapter V contains conclusions and recommendations for future research.

II. Literature Review

Introduction

With the end of the Cold War, and the relative decline in the competitiveness of American industry, defense conversion and technology transfer have received much attention in both the private and public sectors. The United States government is facing many issues dealing with how to maintain the industrial base, how to ensure and sustain technological superiority, and how to effectively transfer technology to the private sector. The private sector is searching for ways to improve their products and processes in order to remain competitive in the global marketplace, as well as looking for opportunities to transition from defense-related work to commercial endeavors. With the current reduction in defense spending and the realization of fewer future major weapon system procurements, the military and industry must efficiently utilize each other's resources to meet their objectives. Our nation continues to be concerned about retaining the capability both in the military and in private industry to provide for our current defense needs and those we will have in the future (Berteau, 1993:2).

This literature review will provide a brief history of our past defense conversion efforts, review some of the recommendations of the Defense Conversion Commission, briefly highlight technology transfer and the federal legislation that promotes its use and makes it a viable means in the defense conversion process, and discuss past research conducted in the technology transfer arena.

History of Past Defense Conversion

Although defense conversion has recently received greater attention and emphasis, it is by no means a new topic. Over the past fifty years, the country has experienced defense drawdowns and conversions three other times, after three major military conflicts: World War II, the Korean War, and the Vietnam War (Stewart, 1993:1). The following sections will briefly summarize the circumstances under which these drawdowns occurred. It includes such things as the economic and defense environments, the industrial base, and some of the federal programs offered. By reviewing past conversion efforts, one gains an understanding of the difficulties and successes encountered in the past. These lessons learned can be funneled in a constructive way to help improve our current defense conversion efforts.

World War II. At the beginning of World War II, the United States was still ailing from the Great Depression. The unemployment rate was 14.6 percent in 1940 and the Gross National Product was $100.4 billion (Stewart, 1993:1). With the onset of World War II, United States industries whole-heartily devoted their efforts into the fight against the Axis. "The mobilization for war and the transformation of the United States achieved between 1940 and 1944 were the most dramatic, massive, and extraordinary in the nation's history" (Stewart, 1993: 1). Approximately one half of the economy was dedicated to the war effort. The levels of production soared to astonishing levels: 86,000 tanks, 296,000 airplanes, 15 million small arms, and more than 40 billion bullets and 64,000 landing craft (Stewart, 1993:2). The conversion from a peacetime economy to a

warfighting economy was swift and dramatic; the entire nation was focused on supporting the war effort.

One of the prominent characteristics of the World War II conversion effort was the advance planning for demobilization and postwar economy. In preparation for peace, the first postwar planning body, the National Resources Planning Board (NRPB) was given responsibility to "collect, analyze, and collate all constructive plans for significant public and private action in the post-defense period" (Stewart, 1993: 5). Although the NRPB was eventually disbanded, planning for the postwar transition was still being accomplished in agencies and the military services. President Roosevelt assigned responsibility for centralized demobilization and postwar economic planning to the Office of War Mobilization (OWM). Demobilization legislation was subsequently passed by Congress. Table 1 highlights some of the more important measures enacted.

A fast conversion of industry from war production to normal peacetime operations was necessary to avoid an economic catastrophe of inflation and high unemployment. The rapid termination of Federal government war contracts, the clearing of war goods from privately-owned plants, the disposing of Government-built and -owned manufacturing facilities, and the sale of war surplus were vital to the success of the conversion effort (Stewart, 1993:8-10). The liberal government policy with regard to contract terminations and amortization for tax purposes directly contributed to the accumulation of capital by industry for postwar reconversion to civilian production (Stewart, 1993:10). The high levels of personal and corporate savings, in addition to the

low interest rates, bolstered customer confidence and encouraged new plant expansions (Lynch and Dickens, 1993:80; Stewart, 1993:10).

TABLE 1

WORLD WAR II DEMOBILIZATION LEGISLATION

Mustering-Out Payment Act of 1944
- Provided for payment of $200 to those with over 60 days of service, plus an additional $100 if any service was overseas

Serviceman's Readjustment Act of 1944 (GI Bill)
- Gave educational benefits to all veterans who served for at least 90 days after September 16, 1940
- Low interest federally guaranteed loans for the veteran's purchase or construction of a home, farm, or business property
- Unemployment compensation - up to $25 a week for 52 weeks
- Job counseling

Contract Settlement Act
- Set up the Office of Contract Settlement which established principles and rules for negotiating claims and settling contract terminations

Surplus Property Act
- Established the Surplus Property Board, charged with planning and supervising the disposal of all surplus property

War Mobilization and Reconversion Act of 1944
- Established the Office of War Mobilization and Reconversion and gave the OWM Director broad reconversion powers

Selective Training and Service Act of 1940
- Provided honorably discharged servicemen, who had left a permanent job in private business or government and were capable of resuming that job, to be reinstated in it

(Stewart, 1993: 7-8)

Another aspect that contributed to the rapid conversion was most major industries did not require massive investments in retooling. Due the advance planning, companies readily knew what they needed to accomplish to transition from war production back to civilian production lines. Many industries were simply returning to doing exactly what they had done before the war.

Ten million veterans returned home by August 1946. Unemployment was 3.3 percent of the labor force (about 2 million people), much lower than the pre-war unemployment of 8.1 million people. Although the United States made great strides forward in productivity, employment, and wealth, inflation presented a problem as it soared to 14.4 percent (Stewart, 1993:12).

It is evident that the advance demobilization and economic planning significantly aided the WWII conversion efforts. President Truman said the conversion was the "swiftest and most gigantic changeover that any nation has ever made from war to peace (Economic Report of the President, 1947: 9). However, after World War II, "America did not want to look at postwar realities in Europe or elsewhere in the world" (Stewart, 1993:23). They wanted the troops home and out of the military, immediately. By 1948, defense spending had plunged to 4.3 percent of GNP from the 1944 peak of 41.4 percent.

Korean War. The Korean conflict was different from World War II. The strategy for the Korean War was to fight with the minimum necessary commitment, while building up slowly for a possible future war with the Soviet Union (Stewart, 1993:29). This meant there was no full-scale national mobilization for Korea. Another difference between the Korean War and WWII was how it was to be financed. Whereas WWII was financed by massive federal deficit spending, the Korean buildup was financed on a pay-as-you go basis as requested by Truman. He wanted to control inflation and have no massive budget deficits as had happened in WWII.

However, similar to WWII, the Korean War buildup was sudden and sharp. From 1950 to 1951 the armed forces doubled in size from 1.65 million to 3.1 million and defense spending soared from 14.3 billion to 33.8 billion (Stewart, 1993: 23)

Many of the conversion efforts following the Korean War were based on World War II solutions (Stewart, 1993:29). In September of 1950, Truman signed the Defense Production Act which allowed him to impose rationing and credit restrictions, make allocations, grant production loans, establish priorities, and control wages and prices, if necessary. The Revenue Act of 1950 was also signed to raise $4.7 billion that fiscal year by raising corporate and personal income tax rates and some excise rates, and an additional $11 billion was appropriated to build up the military to a permanent force strength of 3.2 million (Stewart, 1993:30). Although the Economic Stabilization Agency was established to destroy any inflationary trend in its early stages, it failed miserably. Consumers were panic buying, thus inflation soared.

Truman, however, believed inflation could be controlled through monetary and credit controls rather than imposing wage and price controls as was done in WWII. He was wrong. Between the outbreak of war and the end of September 1950, prices of 28 basic commodities were up 25 percent (Stewart, 1993: 30). Industries were producing at capacity. On December 15, 1950, President Truman informed the nation to prepare to help "other free nations", to enlarge the armed forces dramatically, and to expand the national economy (Stewart, 1993: 31). Civilian production would be curtailed to allow for the expansion of military production and the armed forces would be expanded to 3.5

million servicemen and women (Stewart, 1993:32). Production of aircraft, tanks, and combat vehicles were significantly increased.

Due to extraordinary defense spending, the economy was booming and most Americans were enjoying economic prosperity. Unemployment dropped to 2.5 percent and real per capita disposable income continued to grow despite rising inflation (Stewart, 1993:32-33). In 1951, the annual real growth in GNP was 10.3 percent.

Massive demobilization of troops and defense spending cuts did not happen following the Korean War as it did after World War II. The nation was determined not to be caught offguard again. To ensure it would be prepared to defend itself and its vital national interest, the nation was committed to a higher level of defense spending (Stewart, 1993:34). Many defense firms stayed in the defense industry to supply the larger, more permanent armed forces with more complex and sophisticated weaponry (Stewart, 1993:34). Defense spending declined only slightly after the war and then remained relatively stable in real terms until the Vietnam War (Lynch and Dickens, 1993:80). The post-Korean War reductions might have been more severe had several major aircraft and electronic firms not diversified into civilian markets such as commercial aircraft, small gas turbines, and heavy construction vehicles (Weidenbaum, 1963:82-83).

No new special fiscal or monetary transition programs were developed to help defense workers or companies make the transition from the war economy to the civilian

economy. However, the transition after the Korean War was considered a success because

> there was disciplined management of the economy...and because the war itself was kept within the bounds of a partial mobilization that did not seriously tax the civilian economy or require radical reconversion afterwards. It was, at least by comparison to World War II, a "guns-and-butter" war. (Stewart, 1993:36)

Vietnam War. The Vietnam War was different than WWII and the Korean War. The Vietnam War began almost inconspicuously and simply continued to grow. Compared to WWII and the Korean War, no central high command was established to coordinate all the economic, military, intelligence and political programs (Stewart, 1993:36). The mobilization for the Vietnam War was more gradual and stretched out than that of WWII and Korea. However, it should be noted that the United States was already at a higher level of military preparedness, thus the ramp-up would appear less extensive relative to the other wars.

Although the Vietnam War occupied a smaller portion of the overall economy than did the Korean War, the nation was already approaching maximum output and employment (Stewart, 1993:37). With production escalating for the war effort, unemployment at 4.5 percent and industry operating at full capacity, war production had to be conducted at the expense of civilian production (Stewart, 1993:37). No price or wage controls were imposed, nor were taxes raised to pay for the war. Inflation resulted.

In the Vietnam era, unlike the Korean War era, some efforts of postwar transition planning did take place. Under the Johnson administration, the Cabinet Coordinating Committee on Economic Planning for the End of Vietnam Hostilities considered

transition actions such as a tax reduction, long-term health, education and environmental programs and public works. However, the committee's recommendations were minimally implemented. Although the Nixon administration did create the interagency Economic Adjustment Committee for addressing the specific adjustment needs of communities and workers, it did not adopt any offsetting macroeconomic stimulus programs (Lynch and Dickens, 1993:80).

Other programs were launched in the early 1960s that would later help in the transition out of the Vietnam War. The establishment of the Office of Economic Adjustment (OEA) in 1961 helped communities deal with the impact of military base and defense plant closings (Mosley, 1985:177). OEA teams would assess a community's strengths and weaknesses and identify potential projects that would aid their economic recovery. The Manpower and Development Training Act of 1962 initially provided up to 52 weeks of pay to displaced workers and was amended several times to increase the amount of pay and weeks of support. By the early 1970s, approximately 29 different federally funded programs were available to help various categories of displaced workers (Stewart, 1993: 40; President's Economic Adjustment Committee, 1985:69-77).

It is important to note that displaced *defense industry workers* have not been the direct beneficiaries of Federal assistance during past drawdowns and rarely have they been the particular targets of a Federal transition assistance program (Stewart, 1993:41). Two strategies that were developed to assist these displaced defense workers were the

Technology Mobilization and Reemployment Program (TMRP) of 1971 and the Tax Code Section 51.

The TMRP was a federal assistance program targeted specifically at displaced defense workers. TMRP provided assistance to defense company scientists, engineers, and technical workers displaced as a result of the Vietnam War drawdown. TMRP provided workshops on job opportunities, counseling on career planning and guidance in preparing resumes for surplus engineers, scientists, and technical personnel. However, due to the lack of information, it is difficult to determine the success of TMRP. One lesson learned from the TMRP is that it is extremely difficult to get a program through the bureaucratic approval and funding process in a timely manner to effectively be able to respond to worker displacement (Stewart, 1993:45).

The Tax Code Section 51 was intended to provide tax incentives for companies who hired and trained displaced workers. Companies could use a portion of the hired defense worker's salary and training expenses as a write off for tax purposes. Although there were several advantages to this approach, the subsequent amendments of Section 51 diluted its effectiveness. The complicated tax rules and the huge amounts of red tape tended to negate any potential credits that companies could receive. Therefore, Section 51 did little to spur employer's efforts to reach out and hire these displaced workers.

During the drawdown of the Vietnam War, the overall economic climate of the country was very unhealthy. Recession hit the economy. No special monetary or fiscal programs to offset the cuts in military spending were implemented (Lynch and Dickens,

1993:81). By 1975, unemployment rose to 8.5 percent, and only 73.2 percent of industrial capacity was being used, the smallest amount since the Great Depression (Stewart, 1993: 38). The industrial sectors of aircraft, ordnance and transportation that had seen the largest concentration of the Vietnam buildup suffered extremely hard when the war started to drawdown. Overall, defense-related industry employment declined from 3.2 million to 2.0 million people in 1972 (Mosley, 1985: 176).

Another condition that made it difficult for defense firms was their specialization. Between the Korean War and the Vietnam War, defense production became so specialized that it became difficult for defense firms to directly transfer their military production skills to civilian markets (Stewart, 1993:38). Defense firms were experiencing very difficult times.

Conclusion. When reviewing the past conversion efforts, several observations can be made. First, although WWII is considered a successful example of massive defense conversion; it was more a special instance of defense *reconversion* (Adelman and Augustine, 1993 : 29; Gordon and McFadden, 1984:68). Most wartime defense plants were temporary and reverted back to their prewar civilian operations when the war ended.

Second, when comparing the relative scale of these three major conflicts, World War II dwarfs all the others. The WWII conversion of society was rapid and dramatic, and without equal in the nation's history (Stewart, 1993: 53). The buildups for the Korean and Vietnam Wars and the Reagan era were, in real terms, virtually the same in scale. Although essentially the same amount of money was spent each of these times,

those "equal" amounts were increasingly smaller portions of the national economy, as depicted in Table 2.

TABLE 2

SCALE OF MOBILIZATION AND DEMOBILIZATION

	Up (increase in defense spending as a percent of GNP)	Down (decrease in defense spending as a percent of GNP)
WWII	39.1	37.1
Korea	8.2	3.7
Vietnam	1.8	1.4
Reagan	1.0	1.0 (through 1991)

(Stewart, 1993:54)

In regard to the demobilization following the Korean, Vietnam and now following Reagan era buildups, the GNPs (using constant 1982 dollars for comparison) in 1954, 1969, and 1990 were 1.4 trillion, 2.4 trillion, and 4.2 trillion, respectively. Thus, the defense resources being released in the current defense drawdown *should* be more readily absorbed by today's larger economy than they have been in the past. However, this is a very parochial view and one cannot ignore other factors that come into play, such as the current economic situation, the rate of overall economic growth, and the macroeconomic policies that are being implemented (Kapstein, 1993:xii-xiii).

The key factor in determining whether a defense drawdown will be successful is the dynamic growth rate of the overall economy (Stewart, 1993:55; Kapstein, 1993:xii). The eventual renewal of economic growth "saved" the United States following each of the major drawdowns (Kapstein, 1993:xiii). If the economy is at full employment and is growing well, then the newly released resources can be absorbed and put to work.

However, if the economy is not at full employment and the growth rate is not sufficient, then the released defense resources simply enlarge the already idle pool of resources.

By examining past conversions, we can apply the lessons learned to our future defense conversion efforts. The post-Vietnam conversion experience is perhaps the most relevant to our contemporary situation. Just as defense firms had a difficult time after the Vietnam conflict, they too face a difficult time with the end of the Cold War and the reduction in defense spending. Their increased specialization continues to make it more difficult for companies to convert quickly and successfully to civilian production (Stewart, 1993:52).

Defense Conversion

Defense conversion can be viewed in many different ways. Some consider conversion in the rather restrictive fashion of "rebuilding specific facilities currently used for defense production, with a goal of producing commercial products at that facility using the same workers who had previously worked at the defense facility" (Minnich, 1993:113). This could be considered plant-level conversion. A traditional definition of conversion "says you stop making weapons and you start making something else, either something for which there is a market or something that is socially useful" (Berteau, 1993:1). The Defense Conversion Commission took a broader perspective and defined conversion as the process by which resources--the people, the skills, the technology, the facilities, the equipment and all the capabilities that today provide for defense--expand

into additional economic opportunities (Defense Conversion Commission, 1992:1; Berteau, 1993:1). For this research, the Defense Conversion Commission's definition is used.

The United States is in the midst of a defense drawdown. As past defense drawdowns have shown, it was not plant level conversion, but the renewal of economic growth that "saved" the United States each time (Kapstein, 1993:xiii). Therefore, defense conversion is most likely to succeed when the economy is growing and generating new jobs (Joint Economic Committee, 1992:34).

Our national challenge of conversion is to seize the opportunity to reallocate to other productive activities the defense resources made available as defense spending declines. It is also to accomplish this reallocation in the most timely and efficient way possible while still preserving the appropriate defense industrial base (Defense Conversion Commission, 1992:4-5).

Defense Conversion Commission. The Defense Conversion Commission (DCC) was formed in April 1992 to report on the effects of the defense drawdown and make recommendations on Government programs designed for facilitating the transition to non-defense endeavors (Defense Conversion Commission, 1992:1). The DCC identified three fundamental roles of the government: (1) promote long-term economic growth, (2) provide temporary assistance during economic dislocations, and (3) ensure sufficient defense capability to retain our technological superiority, maintain ready forces, and continue to operate in a way that shapes events rather than have events shape us (Berteau,

1993: 2). Given those three government roles, the Commission recognized four basic goals for government actions to support the defense transition process: (1) facilitate the transition by encouraging economic growth over the long run; (2) enhance and preserve defense capability; (3) ease the immediate impact on workers, communities, and companies; and (4) improve government programs. These four goals form the basis of the Commission's recommendations (Berteau, 1993:2).

The commission investigated the economic effects of the defense drawdown. As is depicted in Table 3, current defense spending cuts are less severe and occur at a slower rate than those that followed World War II, the Korean War, and the Vietnam War. From a national perspective, the effects of the drawdown appear quiet manageable. However, the impact of the drawdown is concentrated in a few particular geographic areas and industrial sectors (Defense Conversion Commission, 1992:7).

TABLE 3

DEFENSE SPENDING AS A PERCENT OF GROSS DOMESTIC PRODUCT

Era	Peak		Low Point		Difference		Average Change Per Year (%)
	Year	GDP %	Year	GDP %	Years	GDP %	
WWII	1944	39.3	1948	3.7	4	35.6	8.90
Korea	1953	14.5	1956	10.2	3	4.3	1.43
Vietnam	1968	9.6	1978	4.8	10	4.8	0.48
Current	1986	6.5	1997	3.6	11	2.9	0.26

(Stewart, 1993:82-88)

The Commission emphasized the critical importance of economic growth. The key to a successful defense transition is a growing economy (Defense Conversion Commission, 1992:13). Two areas identified by the Commission that they considered important for economic growth are technology policies and programs and general business environment (Defense Conversion Commission, 1992:14).

Technology policies and programs, such as dual-use research, manufacturing extension, and technology transfer programs, have been proposed by many as an effective means of easing companies transition to non-defense endeavors (Defense Conversion Commission, 1992:14). The Commission discovered that applying new technologies to production processes, products, and services tends to be difficult and often time-consuming. So, although technology programs appear to do little to mitigate transition problems in the short run, their potential to spur long-term economic growth makes many of these programs worthwhile (Defense Conversion Commission, 1992:14-15).

Technology Transfer. One program that can provide long-term economic growth is technology transfer. According to Air Force Policy Directive 61-3, technology transfer is defined as:

> Oral or written information or data; hardware; personnel services, facilities, equipment; or other resources related to scientific or technological developments of an Air Force Research, Development, Test and Evaluation activity, provided or disclosed by any means to another Federal agency; a state or local government; an industrial organization; including corporation, partnership, limited partnership, or industrial development organization, university, or other person to enhance or promote technological or industrial innovation for a commercial or public purpose.

Although technology transfer has recently received greater attention and emphasis, it is by no means a new idea. Technology transfer was performed early in the 1900s by the Agricultural Extension Service, which promoted the utilization of agricultural research. In the late 1950s and 1960s, the growth in the space program and the increased attention for Cold War cutting-edge technologies helped contribute to the increased activities involving technological advances (Rood, 1989:14). Since its creation in 1958, the National Aeronautics and Space Administration (NASA) has conducted technology transfer, including a mandate to produce spin-offs from its space program. The Department of Defense and other agencies such as the National Science Foundation (NSF), the Department of Transportation (DOT), and the Department of Health and Human Services (HSS) also became interested in the civilian applications of technologies (Rood, 1989:15). More recently, the trend has shifted toward the commercialization of technologies into end products.

With the enactment of the Stevenson-Wydler Technology Innovation Act of 1980, federal laboratories, besides conducting research for the national good, are now responsible for transferring technology to the public. The application and dissemination of new technologies in the commercial market can increase productivity and therefore, promote economic growth (Defense Conversion Commission, 1992:27). Federal technology transfer programs, such as Cooperative Research and Development Agreements (CRDAs), allow companies to take advantage of federal resources and technology. A CRDA is a mechanism that authorizes the exchange of personnel,

facilities, equipment or other resources toward the conduct of specified a research and development effort consistent with the laboratory mission (Soni, 1994:1).

According to the Commission, current laws and policies provide companies with adequate access to Federal laboratory employees, equipment, and technologies. Some of this technology innovation legislation will be discussed in the next subsection. However, the Commission also recognizes that companies that may benefit from these technologies do not always understand how they could be applied to improve their processes, products, and profitability. To that end, the Defense Conversion Commission endorses efforts, such as CRDAs, to help industry understand technologies that have been developed in Federal laboratories. In addition, the Commission endorses efforts to work with companies and the laboratories to facilitate communication.

Legislation

As was mentioned previously, the Defense Conversion Commission envisioned technology transfer as a means to promote long-term economic growth. The following sections will discuss the background of the legislative initiatives and highlight some of the key technology innovation legislation enacted.

Background. Many contend that the US has slowly lost its dominance in the global marketplace, particularly in the area of high-tech product development (Winebrake, 1992:54). Because of this apparent decline, legislators were concerned and took a more proactive role to help correct this situation. In the 1980's, Congress enacted

legislation in an attempt to enhance the participation between the technological resources of the government and the commercialization capabilities of the US private sector (Bagur and Guissinger, 1987:51). Prior to this legislation, discussed below, there was little incentive for the transferring of technology from the federal laboratories to the private sector.

Technology Innovation Legislation. Despite some of its early successes, technology transfer was not actively undertaken until Congress mandated involvement. Table 4, Technology Innovation Legislation, highlights some of the technology transfer legislation. Recent legislation has created opportunities for the private sector to use the resources of the federal laboratory system.

The University and Small Business Patent Procedure Act, commonly known as the Bayh-Dole Act of 1980, gave nonprofit organizations and small businesses the right to retain patents for technology developed with Government funds. This was the first law to provide an incentive to promote inventions made under federal contract (AFMC Technology Transfer Handbook:A-1).

In 1980, Congress enacted the Stevenson-Wydler Technology Innovation Act (Public Law 96-480), which required federal laboratories to take an active role in technical transfer. Congress states that technology and industrial innovation are central to the economic and social well-being of the citizens of the United States and the government investment in the laboratories must contribute to US industrial innovation. It established the Offices of Research and Technology Application (ORTA) within the

TABLE 4

TECHNOLOGY INNOVATION LEGISLATION

Stevenson-Wydler Technology Innovation Act of 1980 (Public Law 96-480)

- Focused on dissemination of information
- Required federal laboratories to take an active role in technical cooperation
- Established Offices of Research and Technology Application at major federal laboratories
- Established the Center for the Utilization of Federal Technology

Federal Technology Transfer Act of 1986 (Public Law 99-502)

- Made technology transfer a responsibility of all federal laboratory scientists and engineers
- Mandated that technology transfer responsibility be considered in laboratory employee performance evaluations
- Established principle of royalty sharing for federal inventors and set up a reward system for other innovators
- Legislated a charter for Federal Laboratory Consortium for Technology Transfer and provided a funding mechanism for that organization to carry out its work
- Empowered each agency to give the director of GOGO laboratories authority to enter into cooperative R&D agreements and negotiate licensing agreements with streamlined headquarters review
- Allowed directors of GOGO laboratories to negotiate licensing agreements for inventions made at their laboratories
- Provided for exchanging GOGO laboratory personnel, services, and equipment with their research partners
- Allowed current and former federal employees to participate in commercial development, to the extent there is no conflict of interest

Omnibus Trade and Competitiveness Act of 1988 (Public Law 100-418)

- Places emphasis on the need for public/private cooperation on assuring full use of result of research
- Established centers for transferring manufacturing technology
- Established Industrial Extension Services within states and an information clearinghouse on successful state and local technology programs
- Changed the name of the National Bureau of Standards to the National Institute of Standards and Technology and broadened its technology transfer role

National Competitiveness Technology Transfer Act of 1989 (Public Law 101-189)

- Granted GOCO federal laboratories opportunities to enter into CRDAs and other activities with universities and private industry
- Allowed information and innovations brought into, and created through, CRDAs to be protected from disclosure
- Provided a technology transfer mission for the nuclear weapons laboratories

(Federal Laboratory Consortium, 1994: VII-XVIII)

federal laboratories to disseminate information about federal products, processes, and services. It also stipulated that each federal agency was to make available not less than 0.5 percent of its R&D budget for transfer activities.

In 1986, the Federal Technology Transfer Act (Public Law 99-502) amended the Stevenson-Wydler Technology Innovation Act. This law made technology transfer a responsibility of all federal laboratory scientists and engineers and mandated that technology transfer responsibility be considered in laboratory employee performance evaluations. The Federal Technology Transfer Act further authorized government-owned, government-operated (GOGO) laboratories to enter into cooperative research and development agreements (CRDAs) and to negotiate licensing agreements. Furthermore, this Act provided for the exchange of GOGO laboratory personnel, services and equipment with their research partners, and allowed current and former federal employees to participate in commercial development, to the extent that there was no conflict of interest.

The Omnibus Trade and Competitiveness Act of 1988 (Public Law 100-418) placed emphasis on the need for public/private cooperation on assuring full use of results of research. It also established centers for transferring manufacturing technology and developed Industrial Extension Services within the states.

In 1989, the National Competitiveness Technology Transfer Act granted government-owned, contractor-operated (GOCO) federal laboratories opportunities to enter into CRDAs and other activities with universities and private industry. It also

allowed information and innovations brought into, and created through, CRDAs to be protected from disclosure.

To further facilitate and encourage technology transfer to small business, the National Department of Defense Authorization Act for 1993 (Public Law 102-35) was passed.

The policies of the Defense Conversion, Reinvestment and Transition Assistance Act of 1993 (the "Defense Conversion Act") and the President's Technology Initiative of 1993 were instituted in part to address the economic impact of the defense downsizing and its adverse effects on the private sector (AFMC Technology Transfer Handbook: B-1). The Defense Conversion Act established a series of defense reinvestment efforts, such as the Technology Reinvestment Project (TRP), Workforce Programs, and Dual Use Technology Programs, that were funded in the FY93 DoD Appropriations Act with $1.7 billion (Lessure, 1994:1-10; AFMC Technology Transfer Handbook: B-1). For example, TRP includes such efforts as Advanced Research Projects Agency (ARPA) Dual-Use Partnerships, Advanced Manufacturing Technologies, and Regional Technology Alliances, to name a few. The Technology Initiative encourages federal laboratories to devote 10-20 percent of their budgets to partnerships with industry to promote dual-use technology projects. The overriding goal was to use the federal research system to promote activities that ultimately result in the creation of new jobs in the private sector (AFMC Technology Transfer Handbook: B-1).

Conclusion. Clearly, significant legislation has been enacted to advance the efforts of technology transfer. The private sector has gained access to the federal laboratories' vast array of resources. By opening the communication lines and providing incentives such as royalty income, both government and private industry benefit from technology transfer.

Past Technology Transfer Research

A review of literature indicates that technology transfer has been the subject of much research. It is evident that the current emphasis on technology transfer, as well as the potential long-term economic benefits resulting from such transfers, have encouraged research in the area. Research has been conducted in various aspects of technology transfer, to include transfer models, transfer mechanisms and barriers, and evaluation of technology transfer programs.

Technology transfer models have served as a subject of research. Jon Sandelin of Stanford University's Technology Licensing Office identified three technology transfer models, whose names are based on their dominant organization function: the legal model, administrative model, and the marketing model (Carr, 1992:15). Other technology transfer approaches include Gibson and Niwa's communication based model, cognitive mapping, and the Technology Transfer Continuum, which view technology transfer as a continuous, evolving process, involving every aspect of a corporation (Gibson and Niva, 1991:179). Another research effort discusses a strategic-positioning

model that is specifically targeted for defense and aerospace contractors (Bers, 1993:67). This model is concerned with all the organizational changes that are required to successfully focus a defense firm's core competencies onto other economic sectors (Bers, 1993:67).

Research has also been performed to investigate technology transfer mechanisms. One research study was conducted to determine the type and extent of interactions between federal laboratories and private companies. In 1988, corporate members of the Industrial Research Institute (IRI) were surveyed on their company's interactions with federal laboratories (Roessner and Bean, 1994:59). This survey collected data that served as a baseline for subsequent research. In 1992, another survey of IRI members was accomplished to collect data on IRI's interactions with federal laboratories during the past two years, as well as to address questions concerning the barriers to more effective technology transfer, the types of interactions that are most beneficial to firms, and the form that these payoffs take (Roessner and Bean, 1994:59). This research suggests that companies interact with federal laboratories for reasons that have far more to do with long-term, less tangible payoffs than with expectations of commercialization (Roessner and Bean, 1994:73). Another study was undertaken to understand the relative effectiveness of various technology transfer mechanisms used in transferring federally funded research and development projects (Winebrake, 1992:54).

Another area of research that has received considerable attention is that of evaluating technology transfer programs. O'Brien and Franks suggest a framework for

evaluating federal technology transfer in terms of short and long range goals and outputs. It outlines critical components of program success and suggest performance indicators through which results could be measured (O'Brien and Franks, 1981:73). Robert Carr also identifies models that reveal how organizations measure the success of their programs (Carr, 1992:19). Some models measure the number of CRDAs created, while others may measure the number of jobs created. Sheahen and others performed an experiment in the field by using a different method to evaluate technology transfer, a peer review (Sheahen and others, 1994:101).

Although much research has been conducted surrounding technology transfer models, mechanisms and measurements, one area that has not been deeply investigated is the role and activities of intermediary organizations that serve as middle men between the technology providers and the industrial users. This thesis investigates the role and mechanisms used by intermediary organizations to facilitate the transferring of technology.

Summary

This chapter has presented a review of past defense conversion efforts, discussed several recommendations of the Defense Conversion Commission, highlighted various laws that encourage technology transfer and reviewed prior technology transfer research efforts. Chapter III will present the methodology used in this research project.

III. Methodology

Introduction

This chapter outlines the process by which the primary data was collected to address the research objective through a case study methodology. First, it describes and justifies the specific method used to study how Miami Valley organizations are facilitating technology transfer activities in the local area. Then, it describes the population of interest, the research instruments used, and data analysis.

Research Strategy

The focus of this research is to investigate and describe how Miami Valley organizations are assisting and facilitating defense conversion efforts, particularly in the area of technology transfer. To effectively study their efforts, a case study was selected as the most appropriate research method.

According to Robert K. Yin, evaluating the following three conditions can help determine the appropriate research strategy for one's research:

1) the type of research question posed;
2) the extent of control an investigator has over actual behavioral events; and
3) the degree of focus on contemporary events as oppose to historical events.

(Yin, 1989:16)

Case studies are the preferred strategy when "how" or "why" research questions are being posed; the investigator has little control over actual behavioral events; and the focus is on a contemporary phenomenon within some real-life context (Yin, 1989:16). Case studies

entail the detailed examination of one or a small number of 'cases', where the unit of analysis is often the organization, departments in organizations, or inter-organizational networks (Bryman, 1989:30).

Furthermore, Yin indicates that the case study method is typically used in the following settings:

1) Policy, political science, and public administration research;
2) Community psychology and sociology;
3) Organizational and management studies; and
4) City and regional planning research, such as studies of plans, neighborhoods, or public agencies. (Yin, 1989:13)

Since this research study certainly meets the three aforementioned conditions and impacts each of these four settings, the case study approach is well-suited for this research.

One area where a case study can be used is in exploring those situations in which the intervention being evaluated has no clear, single set of outcomes (Yin, 1989: 25) This research project falls into this realm and is exploratory in nature. According to Cooper and Emory, exploratory studies are particularly useful when the researcher lacks a clear idea of the problems that will be uncovered during the course of the study (1995:117). The areas of investigation may be so new or so vague that the researcher needs to perform an exploration just to learn something about the problem (Cooper and Emory, 1995: 118). The emergence of these technology transfer "facilitators" in the context of defense conversion is relatively recent. Therefore, the nature of this research objective clearly justifies the use of the exploratory study as described by Cooper and Emory.

One of the recognized drawbacks of case studies is the problem of generalization. With a typical sample size of one, case studies provide no statistical basis to generalize the research results of a single case as being representative of a wider population (Bryman, 1989:172). Although a limitation, case studies can be used effectively in appropriate situations. They are often useful for providing an understanding of areas of organizational functioning that are not well documented, as well as exploring areas to achieve new insights that are useful for building theory (Bryman, 1989:173-174).

Population

The population of interest to this research consisted of hundreds of organizations throughout the nation that are facilitating technology transfer. From this population, the researcher chose a sample size of four organizations from the Ohio Miami Valley region. Time and resource constraints prevented a larger number of organizations from being included in this research. Miami Valley was specifically targeted for two reasons. First, the close proximity of the organizations to the researcher provided for easy access and interaction. Second, the Miami Valley organizations have in their local vicinity a Federal laboratory, Wright Laboratory. This resource provides these organizations with a unique opportunity to take advantage of the available federal technologies developed at the laboratory.

The selection of the four organizations was rationally conducted to ensure a diverse representation that could provide differing perspectives. Since this research is

primarily concerned with organizations spurring economic growth by utilizing technology transfer, it should be understood that *technology* in and of itself is only one piece of successful technology transfer. Colonel Dave Milam (USAF, retired) expresses the essential tools for successful technology transfer in the following "success equation":

$$T^2 = T \times E \times C \times GBP \qquad (1)$$

where T^2 = Technology transfer success based on new or improved products
T = Technology
E = Entrepreneurial spirit
C = Capital
GBP = General Business Practices

(Deffeyes, 1994:18; Milam, 1995)

From this equation, it is obvious that other factors play a significant role in successful technology transfer. Therefore, the selection of certain organizations gives considerable attention to other aspects of the equation rather than the technology itself. To ensure diverse organizational perspectives, the researcher selected the following four organizations: one organization intimately linked with the actual technology provider (Office of Research and Technology Applications), one performing the role of intermediary between the technology provider and technology users (Wright Technology Network), one concerned with a particular industry and process orientation (Edison Materials Technology Center) , and one involved with technology business proposals (National Center for Industrial Competitiveness). These organizations adequately represent the various niches developed to address this community's specific needs.

Research Instrument

Data were collected primarily through personal interviews and through analysis of organizational documents and brochures. The personal interview was selected because it allows for the gathering of more detailed and specific information. According to Cooper and Emory, personal interviews allow the interviewer to probe and gather supplemental information (1995: 271). Focused interviews were conducted in an unstructured fashion, utilizing open-ended questions. A funnel approach, moving from more structured questions to unstructured questions, was used to guide the discussion, as well as limit its scope. In order to fulfill the research objective, most of the questions were open-ended or unstructured, thereby encouraging the respondent to talk freely about the topic and give specific explanations and examples (Cooper and Emory, 1995: 299). By utilizing this interviewing technique, the interviewer had the opportunity to explore various aspects of the topic and the flexibility to probe deeper into areas deemed necessary.

Interviews were conducted by the researcher independently at each of the organization's location. Individuals being interviewed were first contacted on the telephone to arrange for the interview time, as well as familiarizing them with the areas of interest that would be addressed during the interview. This allowed the respondents to comprehend the overall direction of the interview in advance and prepare any information they would desire to have available for the actual interview.

Data Analysis

The analysis of the data was performed by examining the data collected and comparing, contrasting, and integrating the data in order for the researcher to infer general collective findings. The analysis provided a description of the organizations' integrated and collective efforts toward accomplishing the overall goal of promoting economic growth in the local area.

Summary

This chapter presented the research strategy, research population, research instruments, and the data analysis technique. The method of collecting qualitative data was through interviews and documentation review. The data were analyzed through a construction of a case study. Chapter IV presents the results of the data collection effort.

IV. Results and Analysis

Introduction

The objective of this research is to investigate and describe how Miami Valley organizations are assisting and facilitating technology transfer defense conversion efforts to help promote economic growth and development in the local area. This chapter presents the data collected from the four organizations in the case study.

Background

The State of Ohio has taken an active role in the transferring of technology. Through the governor's office, the Ohio Department of Development provides financial backing to intermediary organizations to aid in the facilitation of technology transfer in the local region. Organizations such as Wright Technology Network, Edison Materials Technology Center, and National Center for Industrial Competitiveness were established to help promote the economic development and growth in Ohio. These organizations are ideally situated to take advantage of the federal laboratory resources located at Wright Laboratory. The following sections describe each individual organization's efforts in fostering technology transfer and encouraging economic growth and development in the region.

Office of Research and Technology Application

The Stevenson-Wydler Technology Innovation Act of 1980 established Offices of Research and Technology Application (ORTA) at major federal laboratories. This Act also stipulates that all federal laboratories with more than 200 scientific, engineering and related technical positions shall provide one or more full-time equivalent positions as staff for its ORTA.

Wright Laboratory, located in Dayton, Ohio, is a premier federal laboratory that maintains world class research and development facilities in materials, avionics, propulsion, flight dynamics, and crew systems. The Lab's Office of Research and Technology Application is located in the Plans Directorate, as depicted in Figure 1. The ORTA staff currently consists of five individuals, whereas Wright Laboratory has more than 2,000 scientists and engineers.

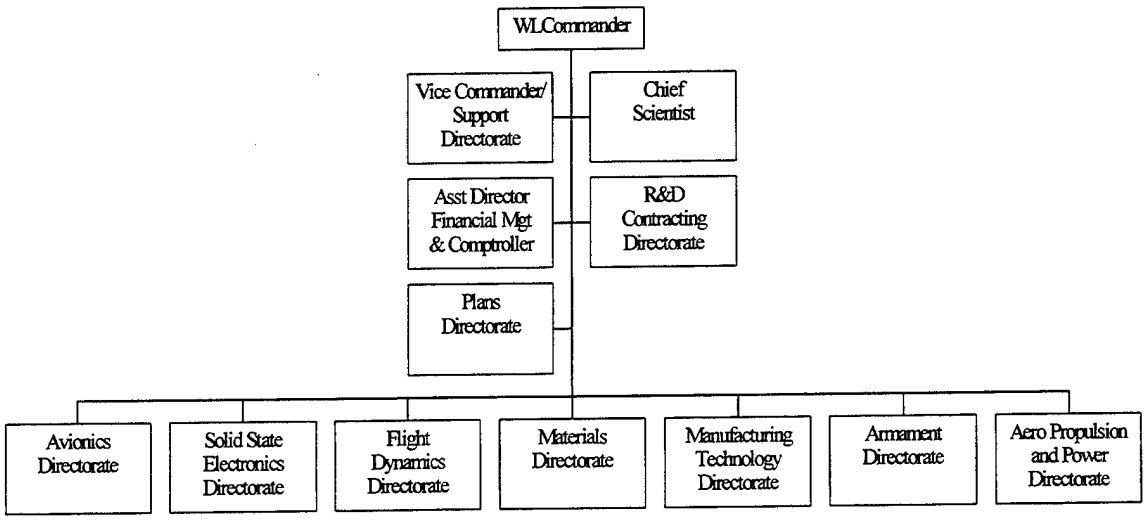


Figure 1. Wright Laboratory Organizational Chart

Specific functions of ORTAs, as stated in United States Code, Title 15 §3710, are:

1) to prepare application assessments for selected research and development projects in which that laboratory is engaged and which in the opinion of the laboratory may have potential commercial applications;

2) to provide and disseminate information on federally owned or originated products, processes, and services having potential application to state and local governments and to private industry;

3) to cooperate with and assist the National Technical Information Service, the Federal Laboratory Consortium for Technology Transfer, and other organizations which link the research and development resources of that laboratory and the federal government as a whole to potential users in states and local government and private industry;

4) to provide technical assistance to state and local government officials; and

5) to participate, where feasible, in regional, state and local programs designed to facilitate or stimulate the transfer of technology for the benefit of the region, state, or local jurisdiction in which the federal laboratory is located.

Individuals in the ORTA are responsible for the day-to-day management of Wright Laboratory technology transfer program. The ORTA staff handles requests for information and assistance that come in from businesses, universities, state and local governments, and other military organizations. The inquiries for technological support are initially screened to determine if they are reasonable, relatively clearly defined, and an American business. Those that meet the criteria are handed over to the appropriate Wright Lab technology directorate or are directed to other federal labs or organizations that can provide assistance. The ORTA also coordinate and monitor the Wright Laboratory Cooperative Research and Development Agreements (CRDAs). Wright

Laboratory currently has 77 CRDAs with various partners throughout the United States, as illustrated in Figure 2.

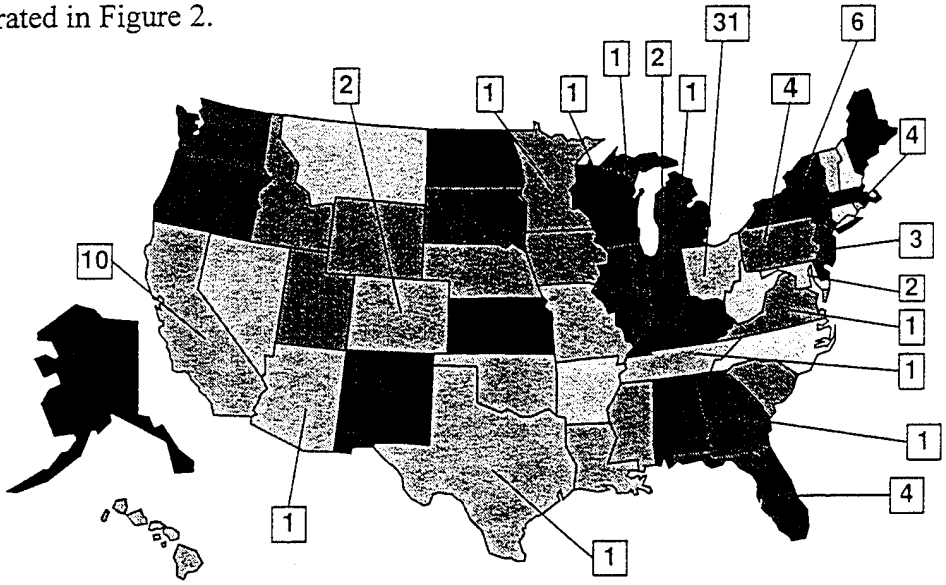


Figure 2. Wright Laboratory CRDAs (Hale, 1995)

To help the ORTA conduct its technology activities, each of the seven technology directorates has a technology transfer focal point. They help match the laboratory scientist with the technological know-how to the industrial partner who has a particular need. To encourage technical communication and information dissemination, the technology transfer focal points meet with the ORTA staff monthly to review technology activities and bring forth issues.

The ORTA consistently uses both formal and informal methods of marketing and outreach. Advertising, conferences, symposiums, displays, published articles and newsletters are several formal means the laboratory uses to market its technologies. For example, ORTA provided seminar briefings on laboratory technologies that could be

applied to auto racing at the *Performance Racing Industry's Trade Show*. Furthermore, articles have been published highlighting some of the potential racing applications (Yunick, 1995:68). The ORTA also uses informal marketing, which is typically accomplished by word-of-mouth and personal one-on-one interaction.

Although federal laboratories' technology are available nationally, the Wright Laboratory ORTA tends to specifically target audiences with a "market pull" type strategy. Market pull, as opposed to technology push, occurs when the customer is the driving force searching for a technological solution to solve a commercial need or problem. Technology push typically occurs when some technology is developed and it is being "pushed" out of the laboratory to the market, thus being available to be used in whatever commercial applications are deemed suitable. Due to the diverse nature of laboratory technologies and the laboratory's unfamiliarity with commercial industrial needs, the "market-pull" helps ORTA and the laboratory personnel because the client has identified a specific need or requirement that they need help with. Since the client has significantly narrowed the focus to a particular technology area, the laboratory is able to address their specific needs in a more efficient manner than it would in a typical "technology push" scenario.

The ORTA receives its funding from the laboratory's R &D budget. As indicated in 15 U.S.C. §3710(b),

> "...each Federal agency which operates or directs one or more Federal laboratories shall make available sufficient funding either as a separate line item or from the agency's research and development budget to support the technology transfer function..."

According to President's Clinton's Technology for America's Economic Growth, A New Direction to Build Economic Strength Report, federal laboratories should aim at devoting at least 10-20 percent of their budgets to R&D partnerships with industry (1993:9). The ORTA is authorized to use this money for activities such as technology assessment, marketing, commercialization, travel and awards (Borchardt, 1994:3).

As the technology marketers for Wright Laboratory, the ORTA opens Wright Lab's doors and offers its discovery and development as a rich and powerful resource for American's private sector (Wright Laboratory, undated: 6). The use of CRDAs encourages businesses to tap into the technological resources available at federal laboratories. From the interchange of information and sharing of ideas, America's industrial base for military leadership and global competitiveness can be maintained and enhanced.

Wright Technology Network (WTN)

The Wright Technology Network (WTN), previously known as the Ohio Advanced Technology Center (OATC), was chartered in 1989 as a non-profit organization. Ohio State Senator Charles Horn pioneered the effort to create an organization that could move the technology out of Wright Laboratory into Ohio industry to boost the local economy (Jones, 1995). With his influential backing, the state of Ohio financed the OATC operations until 1994. Since Wright Laboratory is a federal laboratory, its technological resources could not be constrained to solely benefit Ohio.

Wright Laboratory wanted OATC to branch out and be more regionally oriented. This change would allow the Air Force to provide additional support to OATC in its regional activities. In 1994, OATC's focus shifted from a single state emphasis to that of a multi-state emphasis, thereby requiring the name change to Wright Technology Network. WTN is primarily funded through the Ohio Department of Development and the United States Air Force. This funding is used primarily to cover the operating costs of the organization such as personnel salaries (Hunter, 1995).

Under the provisions of 15 U.S.C. §3715(a) and (b), Wright Laboratory was able to enter into a memorandum of understanding with WTN, the partnership intermediary, and provide federal funds to WTN for the support of technology transfer functions. According to 15 U.S.C. §3716(c), a partnership intermediary refers to

> an agency of a State or local government, or a nonprofit entity owned in whole or in part by, chartered by, funded in whole or in part by, or operated in whole or in part by or on behalf of a State or local government, that assists, counsels, advises, evaluates, or otherwise cooperates with small business firms that need or can make demonstrable productive use of technology-related assistance from a Federal laboratory...

This partnership intermediary arrangement between WTN and Wright Laboratory was the first of its kind in the Department of Defense (Jones, 1995). WTN is currently working to obtain additional funding from the other states in the Great Lakes region. WTN is a regional consortium for technology exchange between industry and government. Its regional emphasis spans the eight Great Lakes states, West Virginia and Kentucky.

WTN's mission is to match technology with industry needs. In order to perform that mission, WTN promotes the expertise and technologies of Wright Laboratory and

other private, state and federal resources. WTN has a representative co-located at Wright Laboratory. By having direct personal access to the laboratory, WTN can readily assist industry in developing products and improving processes to achieve greater economic competitiveness. WTN technology specialists act as the link between the mature technologies and the industry user/products. With a combination of personnel with backgrounds in commercial industry and those with previous work experience at Wright Laboratory, WTN can assess the technological needs of clients, and lead them to points of contact in the laboratory community that can provide assistance. A client will make an inquiry to WTN about a particular problem or need. WTN, with its familiarity and knowledge of laboratory technologies, knows approximately where in the lab this need could best be addressed. WTN searches to find the right match between the customer needs and the scientist/engineer with the appropriate technology know-how. It then arranges the meeting of the client with the scientist. So in essence, WTN performs much of the same functions as the ORTA, but it also brings a commercial/industrial perspective to the table. In addition, WTN augments the work the ORTA can accomplish with its limited staff by providing the additional personnel and time that is necessary to perform these activities. Thus, WTN acts as an extension of the ORTA.

To accomplish its mission, WTN identified three goals:

- To market Air Force technology in order to provide an awareness of potential solutions to industry problems
- To facilitate technology transfer, leading to improved productivity, new products and profitability for regional industry in response to identified opportunities.

- To establish regional alliances in order to provide access to, and generate effective use of all public sector research resources.

(WTN Strategic Plan, 1994:3)

These overall goals are further broken down into numerous objectives that are instrumental to attaining such goals. Although the entire list of objectives is provided in Table 5, two specific objectives, the development of a marketing plan for Wright Laboratory technologies, and the promotion and establishment of CRDAs and providing technology assistance, are discussed below.

TABLE 5

WRIGHT TECHNOLOGY NETWORK OBJECTIVES

- Promote and Establish Cooperative Research and Development Agreements and Provide Technical Assistance
- Develop a Marketing Plan for Wright Laboratory Technologies
- Seek Multiple Funding Sources
- Establish Regional Nodes and Alliances
- Document WTN Success Stories
- Respond to National Technology Transfer Center Technical Requests
- Develop an Organizational Infrastructure Support System
- Provide Access To and Use of Test and Measurement Facilities
- License Patents and Disclosures
- Establish and Maintain a Public Display at Sinclair Community College
- Provide Educational Seminars and Training
- Great Lakes Technology Partnership

Develop a Marketing Plan for Wright Laboratory Technologies. WTN currently has a Memorandum of Understanding (MOU) with Wright Laboratory as a partnership intermediary. According to Air Force Instruction 61-301, Section 2.8:

> Commanders of Air Force Research, Development, Test and Evaluation activities shall support the active marketing of technology transfer services by their activities, including participation in economic development organizations, and contracting with partner intermediaries.

The work pursuant to this MOU is two-fold. First, WTN is to develop and execute a marketing plan for effective technology transfer of Wright Laboratory technology emphasizing small businesses, wherever possible. Second, WTN is to facilitate a process for utilizing the technical talent of scientists and engineers for the infusion of laboratory processes and products into existing companies via technology transfer.

Since federal laboratories typically are not concerned with commercial marketing, nor are they properly suited to plan or perform such activities, Wright Laboratory has contracted WTN to accomplish these tasks. The development and execution of a marketing plan includes the systematic identification of those technologies that have a high potential for commercial applications and successful technology transfer, as well as the development of an orderly method to communicate their technology efforts to prospective clients. WTN has currently identified three technology areas that have high potential for commercial applications: law enforcement, automotive, and medical.

CRDAs and Technical Assistance. One of WTN's objectives is to promote and establish Cooperative Research and Development Agreements and provide technical assistance between Wright Labs and industrial partners. Because of WTN's close relationship with Wright Labs and familiarity with Wright Labs technologies, screening federal technologies for potential matching interests is readily accomplished. CRDAs provide an easy way for industry to collaborate with Air Force Research and Development activities to facilitate technology transfer for the technological and financial benefits of both parties (CRDA Pamphlet, undated). WTN helps industrial clients by

preparing work plans, and expediting CRDA preparation, review, negotiation and signature. For less extensive efforts that do not warrant CRDAs, WTN facilitates technical communication and consultation to help solve process and product crisis problems by acting as an intermediary agent who assesses the industrial company's problems, utilizes its contacts to come up with a solution, and arranges the meeting between the technology provider and the company. Therefore, WTN serves as a middle man who manages the interface between the customer and the technology supplier.

WTN obvious interacts closely with ORTA and the directorates of the laboratory. However, it also works with NCIC and the Edison Centers. WTN performs cost estimates for proposals that NCIC receives. It also refers industrial companies with new technology projects or even entrepreneurs who desire to start-up a new technology company to NCIC for possible financial backing. WTN also refers its customers to the Edison Centers if their specific questions relate to one of the Center's particular technology areas. Thus WTN is utilizing the existing resources of the community to minimize duplication and ensure customers are receiving solutions to their industrial questions.

Edison Materials Technology Center

The Ohio Thomas Edison Program was founded in 1983 by the Ohio Department of Development after Ohio lost 140,000 manufacturing jobs. The Program encourages the formation of consortia of business, industrial, government, academic, and civic

organizations to assure Ohio's economic viability, to expand Ohio's industry, and to create jobs. Each of the Edison Centers offers its own special capabilities in specific technologies, as is shown in Table 6.

TABLE 6

EDISON TECHNOLOGY CENTERS

- Cleveland Advanced Manufacturing Program (CAMP)
- Edison Biotechnology Center (EBC)
- Edison Industrial Systems Center (EISC)
- Edison Materials Technology Center (EMTEC)
- Edison Polymer Innovation Corporation (EPIC)
- Edison Welding Institute (EWI)
- Institute of Advanced Manufacturing Sciences (IAMS)

(Ohio Department of Development, 1993:1-9)

Edison Materials Technology Center (EMTEC), one of seven Edison Centers, is a not-for-profit consortium of industry members, academic institutions, federal laboratories, businesses and civic institutions that can provide solutions to Ohio industries' problems. The particular mission of EMTEC is

> to strengthen Ohio and U.S. industry by promoting the innovative development and application of materials and processing technologies in a united effort with industry, academia, and government.

EMTEC was established in 1987 as a not-for-profit company. Noting this area's heavy industrial emphasis on manufacturing, as well as accessibility to Wright-Patterson AFB, EMTEC selected its home in Dayton, Ohio. EMTEC is structured around a consortium of thirteen universities, six government laboratories, and approximately 105 industrial members. EMTEC has a small core staff of 15 people who attempt to expand already numerous partnerships into an ever-widening pool of problem-solving expertise

to solve problems identified by their members or other companies. Although EMTEC does not have its own internal laboratory, the networking and partnerships prove advantageous by allowing existing resources to be used, thereby minimizing duplication.

EMTEC targets its efforts on already established manufacturing and materials businesses and companies, especially those located in Ohio. EMTEC concentrates on enhancing the competitiveness of its members by focusing on *industry* defined programs designed to infuse consortium-derived innovations and improvements in Ohio materials and materials processing -- the foundation of all manufacturing. In other words, EMTEC collectively brings together industrial members and their funds to work together to solve industrial-wide problems that otherwise may not have been pursued individually due to the large capital expenditure. EMTEC members vote on the initiatives to be pursued, which ensures their individual interests, as well as the industry's, are taken into account. These improvements in materials and materials processing have the potential to greatly enhance the competitiveness of the entire U.S. manufacturing industrial base.

Using the combined strengths of the Edison Center's industry, academic and federal laboratory members, EMTEC strives to develop new industrial materials and processes, improve the performance of existing materials and processes, identify alternative materials and processes, and improve the quality of processed materials. These foci will not only improve existing products, but will provide a strategy for innovating entirely new manufacturing industries and products.

EMTEC currently has 105 industrial members who pay membership fees. Institutional and university members do not pay these fees. Membership fees are determined according to annual gross sales. Minimum membership period is five years, with dues being paid annually. Although membership is not a prerequisite to obtain EMTEC services, members do obtain additional benefits such as those listed in Table 7.

TABLE 7

EMTEC MEMBERSHIP BENEFITS

• Exceptional leverage of member's R&D investment with State grant funds and other industry member funding	• Access to over $1 billion worth of existing, in place resources at no cost to member or EMTEC
• Access to the resources of over twelve academic institutions with well over 100 recognized materials experts on staff plus their extensive facilities, equipment, research experience and reference libraries	• Determination of EMTECs technological and services agenda through an industry-controlled voting process on the Technical Steering Committee and the Board of Governors
• Participation in, and benefit from, joint research, education, and technology transfer	• A means to initiate special, or proprietary, research projects to solve member's specific problems at EMTEC's cost

EMTEC receives funds from Ohio's Department of Development Thomas Edison Program. It also has received federal grants from the Defense Logistics Agency for work in the casting industry and from the National Institute of Standards and Technology for the Manufacturing Extension Program. The purpose of the DLA program is to integrate rapid prototyping, solidification modeling, and computed tomography to produce investment cast rapid tooling for the die casting, permanent mold, and investment casting industries (EMTEC: The Center of Solutions, 1994). EMTEC will coordinate all efforts

to transfer this technology to industry. The Manufacturing Extension Program created a Manufacturing Extension Center for southwest Ohio. This center is designed to help small manufacturers stay competitive in the global marketplace by providing business and technical assistance to manufacturing companies. In addition to these funds, EMTEC receives its membership fees. The funds that EMTEC receives are used to fund technology development projects, pay organizational operating costs, and provide initial consultation (typically up to 4 hours) to non-EMTEC members.

EMTEC utilizes two cost effective mechanisms to assist industry in both short-term problem solving and longer-term technology development projects. The Request for Help (RFH) program provides solutions to a company's most critical "short-fuse" problems for little or no cost. EMTEC facilitates the problem-solving by using its network of expert resources to address the company's specific problem. Companies can contact EMTEC with particular problems. They are better equipped to find answers by tapping into the vast knowledge and resources available through the numerous laboratories, universities and industrial members.

The Core Technology Program is a longer term technology development effort. Companies submit research project ideas that pertain to problems in the industry as a whole. Projects are selected by the member organizations to ensure that the most pressing problems are addressed with the best talent, equipment, and facilities available. EMTEC assists in the funding of these Core Technology Projects. For example, one on-going core technology project is the development of low-cost automotive and industrial

components from low-density, high temperature, aerospace Ti-Al alloys. Sixteen participating organizations collectively provided $1 million and EMTEC provided $560K toward this forty month effort. By leveraging resources, individual members, as well as the industry as a whole, can reap the benefits of improved technological products and processes.

Because of EMTEC's emphasis on materials and materials processing, there exists a close interaction with the Materials Directorate at Wright Laboratory. EMTEC works directly with this Directorate. EMTEC, along with the other Edison Centers, also provides technical assistance to NCIC. WTN often refers industrial users to EMTEC when they have a particular materials question. Therefore, EMTEC is a part of the overall network that shares information and resources to help industrial customers get the answers they need.

National Center for Industrial Competitiveness

The National Center for Industrial Competitiveness (NCIC) was established to respond to the economic conversion needs of the Great Lakes region, which includes Ohio, Illinois, Indiana, Minnesota, Wisconsin, Michigan, Pennsylvania, West Virginia, and Kentucky. NCIC was the result of an effort by the Dayton Area Chamber of Commerce, local area business leaders, the State of Ohio, Congress and the Department of Defense in concert with Wright-Patterson Air Force Base to establish an organization that could facilitate reinvestment in the local region, enhance industrial competitiveness,

and foster new business development (NCIC Business Plan, 1994:I). NCIC is to assist in the preservation of and the creation of high-paying technology-based jobs in the local area.

NCIC is organized as a regional alliance and was incorporated in September 1993 as a not-for-profit corporation. Its mission is to promote economic growth throughout the Great Lakes region primarily through *direct* investment in new technologies and growing enterprises. NCIC supports economic development and job creation by enhancing the industrial competitiveness of existing commercial enterprises, by assisting defense-dependent companies diversify into commercial markets, and by launching a new generation of technology-based industry in the region (NCIC Operating Plan and Budget, 1994:4).

NCIC has received funding from the federal government and the state of Ohio. The federal government has agreed to provide $10 million to stimulate industrial competitiveness in the Midwest (NCIC Operating Plan and Budget, 1994:1). The state of Ohio agreed to match the amount of federal funds, therefore providing NCIC with funds totaling $20 million. Ohio also stipulated the funds would only be used for the benefit of Ohio. NCIC does not expect to receive any federal or state funding in addition to this initial amount. However, NCIC envisions that it will become self-sufficient as the payback mechanisms from established cooperative agreements and other contractual instruments start coming in. NCIC provides this money in the form of direct investment

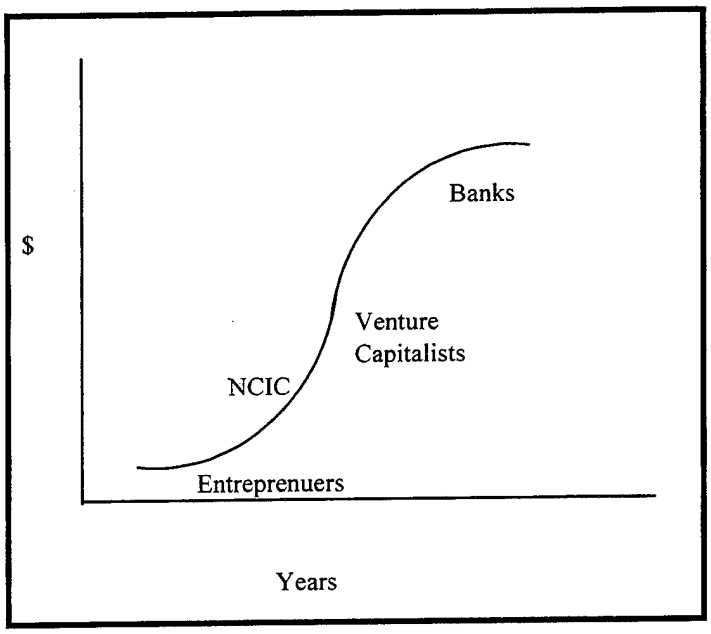


Figure 3. Financial Investment Curve (Hughes, 1995)

loans to technology-based companies, who have approved technology project proposals requesting NCIC funds. NCIC is attempting to assist promising companies by bridging the financial gap that exists in the early stages of more risky technology endeavors, as depicted in Figure 3.

Sixteen separate focus groups were used to identify the appropriate industry/product/service needs that NCIC should emphasize. In the early planning stages for NCIC and with the support of Ronald D. Wine, Montgomery County issued an Economic Development Government Enhancement (EDGE) grant of $80 thousand to assemble these focus groups to develop a detailed business plan. The focus groups were comprised of members from EMTEC, small local companies, larger industrial companies,

the State of Ohio, and the federal government, to name a few. Ultimately, the focus groups decided that NCIC should concentrate its resources on strengthening the core competencies supporting the aerospace and vehicle manufacturing industries (NCIC Operating Plan and Budget, 1994: 13). The core technologies center around advanced materials/structures/processing, manufacturing technologies/machinery/equipment, and information networks/software/data systems. Although NCIC primary focus revolves around these industries and core competencies, it does not preclude them from considering other areas. For example, there has been significant interest expressed in the biotechnology area.

As a regional center supporting specific initiatives to promote economic growth and employment, NCIC receives and evaluates potential technology proposals from companies and then determines which initiatives will receive funding from NCIC. NCIC's primary target audience includes those companies that have previously performed Small Business Innovative Research (SBIR) and those that are trying to convert from defense activities. The breakdown of companies that submit proposals are one-third brand new companies, one-third defense firms that are trying to diversify into commercial markets, and one-third existing commercial companies with a new product line.

In order to make intelligent investment decisions concerning prospective opportunities, NCIC performed research to examine the reasons why businesses typically fail. Their findings are shown in Table 8.

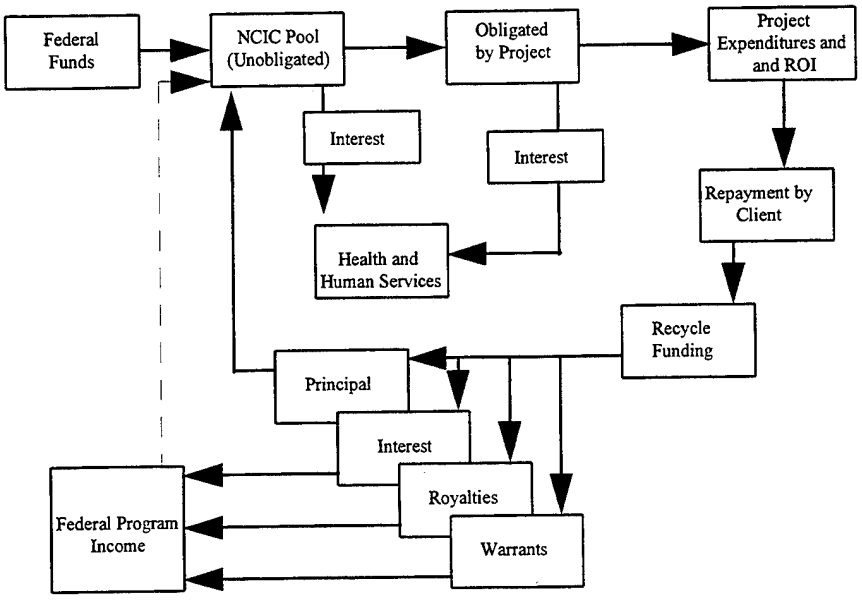
TABLE 8

NCIC TOP SIX CAUSES OF BUSINESS FAILURE

Management Failure	36%
Business Plan Flaws	24%
Capital Shortage	16%
Under Estimated Competition	8%
Product Development Failure	8%
Technology Development	3%

Although many would contend that the innovative technology itself would be the most problematic, it accounts for less than 3% of business failures. NCIC has structured itself so to address these common shortcomings and thereby reduce the risk of failure. They provide companies with financial, technical, market development, and management support.

After NCIC receives a proposal, it evaluates the company's management capabilities and management team and analyzes the business plan to see if they have a formulated a multi-year strategic plan, if they envision where they are going, and if they have business sense. They also perform an independent cost estimate to determine if the capital requirements are realistic. If the Board of Directors of NCIC agrees to fund the project, it will then determine how it will structure its repayment to help assure the success of the project. NCIC offers flexible rates and repayment terms, through interest, royalties, and warrants, that are negotiated on a project by project basis. Because many of these companies do not have fixed assets, NCIC can secure its loan through intellectual



(NCIC Business Proposal Screening, 1995:8)

Figure 4. NCIC Recycling Operation of Federal Funds

property. For example, in the case of software, the company will be required to put the software in an escrow account each month. If they default on the loan, the software is turned over to NCIC, who can then try to resell it to recover their principal. However, if the loan is paid off, NCIC releases its claim to the intellectual property.

Because NCIC is investing in these technology business prospects through a loan-type arrangement, NCIC is able to recoup its funds through principal, interest, royalties and warrants. Figure 4 illustrates how the "recycling" operation of federal funds will provide ongoing revenue for NCIC. The federal funds and the Ohio funds are accounted for separately. This is necessary due to the state of Ohio's requirement that Ohio funds be used only for the benefit of the state. Therefore, there is a similar diagram depicting the recycling of Ohio funds. The recycling operation of the Ohio funds is exactly the

same as that of federal funds, except that interest derived from Ohio funds does not go into Health and Human Services. It is re-entered into the NCIC Pool (Unobligated) that is associated with the Ohio funds. The interest, royalties and warrants received from the projects constitute Federal and Ohio Program Income. This income is re-routed back into the NCIC Pool (Unobligated), thereby increasing this pool. Thus, program income can *grow* the initial pool of NCIC funds, thereby enabling NCIC to eventually become self-sufficient.

Although NCIC has a regional focus, in 1994 the Board of Directors, which has representatives from the federal and state governments, consciously decided that during the first year NCIC's efforts should be concentrated solely in Ohio. This would allow NCIC to gain some experience before branching out to the other regional states in the fall of 1995. NCIC has currently funded six investment projects with overall total project costs ranging from $125K to $1.5 million, while NCIC's financial investment for these projects has ranging from $50K to $320K. Three of the initial funded projects are defense conversion efforts dealing with avionics hardware and software, electromembrane fractionation, and the establishment of printed wiring board research center at the Mound. Six other projects have been approved for investment funding and seventeen others are pending.

NCIC interacts with the other organizations such as EMTEC, WTN, and Wright Laboratory. NCIC may refer their clients to EMTEC for materials or manufacturing processing assistance if their project risks are high in this area. NCIC is directed by the

state of Ohio to go through WTN to obtain technical assistance from Wright Laboratory. NCIC also uses WTN to perform independent cost estimates for the proposals NCIC receives. In addition to these organizations, NCIC uses a multitude of other resources such as Small Business Development Centers, National Aeronautics and Space Administration (NASA) Lewis, Wright State University, and the University of Dayton Research Institute (UDRI).

Conclusion

The emergence of intermediary organizations that facilitate technology transfer indicates an overriding need to link technology providers with industrial users. Intermediaries can be useful in ensuring that users and providers of technologies successfully communicate with each other by translating the problem or by suggesting new applications for existing technologies (Rood, 1989:16).

Each organization discussed above filled a particular market niche. NCIC helps bridge the gap by investing in businesses with promising technological innovations. NCIC is the only organization researched that directly lends money to technology-based companies in an effort to assist them in the early stages of start-up or emergence of a new product. WTN helps industrial users link up with the appropriate technology provider to solve problems or help them engage in cooperative research and development agreements. WTN performs much of the same functions as the ORTA. EMTEC helps the materials and manufacturing industries by providing consultation and assisting in

long-term core technology projects that can improve materials processing. EMTEC is unique in that its scope is narrowly defined to a specific industrial technology. It also is different in that its members and clients are typically already well-established companies.

Although each organization has its own specific focus, they all commonly exist to aid in the goal of assisting the transferring of technology and promoting economic growth and development. In addition, all the organizations receive funding in one form or another from the federal and state governments.

The networking and interaction among the organizations are vital to their success. The directors of these organizations meet once a month to keep abreast of each others activities and discuss any business or technology related issues. The organizations themselves are aware of the each others resources and are familiar with the assistance that each can provide. It is apparent that a cooperative environment exists among these organizations. By utilizing the expertise of already existing resources, these organizations can minimize duplication and be more effective. For example, WTN provides cost estimating assistance to NCIC on the business proposals it receives rather than having NCIC develop this capability. Wright Laboratory is a key resource that is valuable to all these organizations. The technical expertise available at this federal laboratory, along with its high-tech facilities, can be used to help solve problems in the commercial sector.

One of the major advantages of networking is the pooling of resources that are available to one another. Whether it be a particular solution to a problem or merely the

name of an individual to contact, networking helps promote sharing of ideas, experiences, and knowledge. The pooling of financial resources also allows individuals to collectively come together to solve larger problems that otherwise may not have been undertaken. By leveraging resources, individual businesses and industries as a whole can benefit from improved products and processes that can stimulate economic growth and development.

Summary

This chapter presented the data collected from the four organizations studied. The data addressed the role each organization plays in the Miami Valley technology arena, the mechanisms and means by which the organizations accomplish their mission, and the interaction that the organizations have with other organizations. Chapter V will present conclusions and recommendations for future research.

V. Conclusions and Recommendations

Introduction

An assessment of the data gathered from the interviews led to a number of conclusions about how Miami Valley organizations are facilitating technology transfer activities to promote economic growth. This chapter presents these conclusions and provides recommendations for future research.

Conclusions

The analysis of the data collected from the Miami Valley organizations investigated in this research indicates several overriding observations. Generally, these organizations are in the infantile stages of development. Therefore any in-depth analysis to evaluate the success of their efforts is premature. However, this should be expected since technology transfer is being implemented as a long-term strategy to encourage economic growth and development.

Roles of Organizations. The overriding goal for all the intermediary organizations was to provide technological solutions to Miami Valley industries and businesses in order to promote and encourage economic development and growth. The intermediary organizations studied were typically focused in particular market niches. The ORTA, being part of a federal laboratory, had a broad range of roles and functions it was to accomplish. The ORTA manages the day-to-day technology transfer efforts of Wright Laboratory, by assisting any technical inquiries coming in to Wright Laboratory, as well

as monitoring Wright Laboratory CRDAs. NCIC is in the business of directly lends money to technology-based companies in an effort to assist them in the early stages of start-up or emergence of a new product. Therefore, NCIC is helping bridge the gap by investing in businesses with promising technological innovations. WTN, on the other hand, assists industrial users in the Great Lakes region in solving their individual problems. WTN matches the user with the appropriate technology providers to help solve their particular problem. WTN also helps coordinate cooperative research and development agreements between industrial clients and the laboratory. EMTEC focuses on Ohio's materials and manufacturing industries. EMTEC helps these industries by providing consultation and assisting in long-term core technology projects that can improve materials processing. EMTEC is unique in that its scope is narrowly defined to a specific industrial technology. Because these organizations were targeted at particular market areas, there appeared to be very little overlap. However, the research indicates that the overall mission of the organizations could indeed result in the overlapping of services. For example, because WTN has the broader scope of the Great Lakes region, its efforts can overlap and duplicate the more succinctly defined role of the Edison Centers, which is more concerned with Ohio industry. Although it is uncertain whether this duplication actually exists, one area where it appears likely to occur is in the materials and manufacturing technology areas.

Mechanisms/Methods. The intermediary organizations used numerous mechanisms such as cooperative research and development agreements (CRDAs), loans,

and consortia to accomplish their missions. ORTA and WTN use CRDAs as a way for industry to collaborate with federal activities to facilitate the technology transfer for the benefit of both parties. WTN also draws upon the expertise of its staff. WTN uses its personnel, which have previous Wright Laboratory experience, to assess where in the Wright Laboratory specific industrial problems should be directed. Thus, WTN exploits its personnel and their laboratory contacts to help them perform their job. NCIC utilizes proposals and loans as its means of accomplishing its mission. NCIC analyzes and assessing companies technology projects and provides approved companies with capital loans. EMTEC uses its consortium of universities, government laboratories, and industrial members to develop and improve new materials and materials processing techniques. Two mechanisms that are used to assist industry are EMTEC's Request for Help (RFH) program, which provides solutions to a company's most critical "short-fuse" problems for little or no cost; and its Core Technology Program, which provides for longer term technology development efforts that can be used to address industry-wide problems.

Interactions. The research indicates that a cooperative relationship and a strong network exists among these intermediary organizations. Each organizations was familiar with each other's missions and areas of expertise. It would not be uncommon for organizations to refer customers to one another. The sharing of information and interactive networking among all the resource providers ensured clients' needs would be

fulfilled in the most appropriate manner. Therefore, networking was used as an effective force multiplier, as well as an additional means of advertisement.

These intermediary organizations effectively use existing resources and each other. For example, NCIC has WTN perform cost estimates on the technical proposals it receives, rather than creating its own internal capability. Wright Laboratory personnel work closely with all the regional technology transfer organizations and commercial industries to help identify potential technology applications that can be utilized in the commercial sector. The laboratory also helps organizations like NCIC assess the technical feasibility of the technology project proposals. By utilizing existing resources, duplication is minimized and efficiency is achieved

The success of these intermediary organizations is dependent upon the combination of strong networking, personal contacts, business experience and technical know-how. They must be able to assess their clients' needs and utilize the resources available to them. By leveraging each others resources and funds, industries and individual companies can make significant strides forward that are beneficial for themselves and the economy of the United States.

Recommendations for Future Research

While this research focused on how organizations were facilitating technology transfer to spur economic growth, three other opportunities for future research are evident in the area of technology transfer.

First, a study should be accomplished to investigate and determine how other states and regions are transferring technology to their regions. This study could be expanded further by benchmarking Miami Valley intermediaries against these other state and regional intermediaries.

Second, a study should be conducted to evaluate the utility of these intermediary organizations and to determine what role they ***should*** play in the transfer of technology and how they ***should*** be accomplishing it.

Third, a study should be accomplished to examine the return on investment that is received from the funds that are provided from the federal government and the state to these intermediary organizations. This study would need to be accomplished after several years of data are available.

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13. ABSTRACT *(Maximum 200 words)*

Major changes in the geopolitical environment and the social and economic needs of the United States have resulted in resources being shifted away from national defense. Although the expected decrease in defense spending should not be harmful in macroeconomic terms, it can be devastating locally. To mitigate the effects of the drawdown, individual states and local communities must search for ways to bolster their local economies. One avenue that can be pursued to enhance future economic growth is the transferring of technologies to the commercial sector. Intermediary organizations have emerged to facilitate the process of technology transfer by serving as the bridge between technology providers and industrial users.

This research investigates and describes how intermediary organizations are assisting and facilitating the technology transfer defense conversion efforts. A case study examines how four Miami Valley organizations in Ohio are helping to promote economic growth and development in their local area via technology transfer.

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